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Measuring the perceived effectiveness of decision support systems and their impact on performance

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ABSTRACT

This study investigates decision support systems (DSS) by assessing the factors that enhance their perceived effectiveness and their impact on performance. This was achieved by using a simulation exercise with 652 senior graduate students who developed DSS and reported on the systems created. Our analysis shows that DSS users who perceive the system as effective correlate to improved company performance. However, investing significant human resources in developing a system does not necessarily guarantee enhanced performance. In addition, the study exemplifies how user traits can impact perceived effectiveness.

1. Introduction

Companies worldwide use decision support systems (DSS) to provide computer-based support for decision makers charged with solving semi-structured and unstructured problems. Studies show that DSS are effective if the users' design objectives or performance expectations of the system are met (Kamis et al. [25]). This is because the information needs of the users (the decision makers) are appropriately supported by the DSS (Lawrence et al. [29]; Khazanchi [27]). Moreover, recent information systems studies use subjective measures, such as user experience, perceived enjoyment and usefulness, to stress the importance of cognitive and affective perceptions in DSS (e.g., Kamis et al. [25], Chen and Lin [6]). In addition, users today are more involved in the development process of the system they eventually use (Fjermestad and Romano [15]). Therefore, it is vital to better understand the relationship between system development and user involvement in the development process (De Kok et al. [11]; Quinn [40]). Consequently, the question of measuring the effectiveness of DSS appears to be the providence of the user (i.e., perceived effectiveness).

This study investigates the factors that enhance DSS perceived effectiveness. We use a simulation method for this research, where the simulation functions as the platform for participants to experience DSS. This research follows an approach akin to that of Ben-Zvi [3] who considered a DSS simulation and its educational efficacy. We augment the investigation by shifting the focus to the systems, the users, and the impact on performance. Classes of students formed groups and participated in a simulation exercise. The groups, simulating companies in an industry, developed DSS that were later characterized and analyzed. In addition, several variables related to DSS perceived effectiveness were evaluated and compared to group performance.

The remainder of the paper is organized as follows: First, we review information systems literature on DSS and set the study's hypotheses. Then, we describe the employed methodology (the simulation). Next, we examine the implementation of DSS in the proposed simulation and analyze related variables. Finally, we discuss the applicability of this study and draw conclusions.

2. Literature review and hypotheses

Information systems studies have employed myriad instruments to measure information systems (IS) effectiveness in diverse settings. For example, Bharati and Chaudhury [5] investigated web-based decision support systems; Crowston et al. [9] examined free and open source software development settings; Reinig [41] studied collaborative technologies such as group support systems and their impact on performance. However, those studies principally focused on the direct effects of system design and use on outcomes and user performance. Fewer DSS studies have integrated decision process variables, such as perceived usefulness, satisfaction, enjoyment, and perceived ease of use (Kamis and Stohr [24]; Todd and Benbasat [45]).

The relatively small number of studies that consider decision process variables in DSS research may be the result of the often-used

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organizational context for such studies, where process variables such as attitudes may appear less important and more generic and therefore harder to capture or measure (Kamis et al. [25]). Also, when DSS serve the unitary purpose of attaining a certain goal, researchers' attention is usually focused on that goal (and ways to achieve it) and less emphasis is placed on DSS process variables (Lilien et al. [31]; Poston and Speier [39]).

Nevertheless, as economic environments increase in complexity, DSS achieve greater prominence. They function as an integral element of the workplace and are used to make strategic decisions, not just to optimize or solve simple work problems (Kamis et al. [25]). Thus, understanding cognitive variables that relate to the DSS, such as perceptions and beliefs and their impact on company performance, becomes extremely important.

Several studies report that the organizational and external environments of information systems are key determinants in the success or failure of information systems (e.g., Ash et al. [1]; Liu et al. [32]). Environmental factors are usually fluid, dynamic, and difficult to control, which invariably distorts the meaning of data collected in trans-organizational comparisons of DSS. Therefore, this study employs a simulation platform in a controlled setting. We use the simulation as a tool for measuring several variables related to DSS. Our objective is to measure the perceived effectiveness of DSS. Therefore, we investigate variables related to DSS use, user satisfaction and performance using a questionnaire.

Empirical studies that measure perceived effectiveness present mixed results. Although some researchers report the successful implementation of DSS (for example, Garrity et al. [18]; Chen and Lin [6]), other scholars provide no support for the premise that the use of DSS improves individual or group decision making effectiveness. For example, Lawrence et al. [29] reported that in the absence of contextual information, adjustments to the recommendations of the system often reduced forecast accuracy and that user participation in the design of the DSS led, in about half the cases, to the selection of models that were far from optimal. In a study of task complexity and DSS, Webby and O'Connor [46] found that the DSS did not affect subjects' performance. Courtney and Paradice [8] argued that many of the decisions they monitored in their laboratory DSS study were "ill-structured". Other researchers, such as Goslar et al. [21] and Kasper [26], reported similar results.

We examine two groups of hypotheses that relate independent variables investigated in IS studies to perceived DSS effectiveness and their impact on company performance. IS researchers have studied the success and failure of DSS from multiple perspectives: Srinivasan [44] examined systems' reliability and flexibility; Garrity and Sanders [17] studied the ability of a system to support decision-making and problem-solving activities; Baroudi et al. [2], DeLone and McLean [12] and Lawrence et al. [29] investigated systems' use and user satisfaction; Bharati and Chaudhury [5] examined information and system quality; Pitt et al. [38] investigated service quality; Goslar et al. [21] looked at decision confidence; Hussein et al. [23] explored technological factors. Ben-Zvi [3] showed strong correlations between the following DSS effectiveness variables:

1. Familiarity with the system
2. Perceived usefulness
3. Use of system
4. Perceived contribution to performance and success
5. User satisfaction
6. Participation in defining the system
7. System meeting its expectations

The first group of hypotheses investigates the relationship between the above variables and DSS perceived effectiveness, as follows:

Hypothesis 1a. Familiarity with the system has a significant impact on system perceived effectiveness.

Hypothesis 1b. Perceived usefulness has a significant impact on system perceived effectiveness.

Hypothesis 1c. The use of DSS has a significant impact on system perceived effectiveness.

Hypothesis 1d. The perceived contribution of the system has a significant impact on system perceived effectiveness.

Hypothesis 1e. User satisfaction has a significant impact on system perceived effectiveness.

Hypothesis 1f. Participation in defining the system has a significant impact on system perceived effectiveness.

Hypothesis 1g. A system that meets its expectations has a significant impact on system perceived effectiveness.

Several IS studies investigated the impact of DSS on company performance: Zopounidis et al. [48] investigated a multicriteria financial evaluation system for the assessment of finance companies; Romano [42] examined how coordination and integration mechanisms interact in a supply chain management system and impact the performance of the whole supply network. Chen and Lin [7] investigated the impact of web-based DSS on company performance.

As perceived effectiveness, including usefulness, ease of use and user satisfaction, measures the degree to which users perceive a particular system as enhancing their performance (Davis [10]), our second group of hypotheses examines the impact of the above DSS variables on company performance:

Hypothesis 2a. Familiarity with the system has a significant impact on company performance.

Hypothesis 2b. Perceived usefulness has a significant impact on company performance.

Hypothesis 2c. The use of DSS has a significant impact on company performance.

Hypothesis 2d. The perceived contribution of the system has a significant impact on company performance.

Hypothesis 2e. User satisfaction has a significant impact on company performance.

Hypothesis 2f. Participation in defining the system has a significant impact on company performance.

Hypothesis 2g. A system that meets its expectations has a significant impact on company performance.

We also hypothesize that as system complexity increases, perceived effectiveness, user satisfaction and company performance will also improve. However, as the complexity increases beyond a certain point, perceived effectiveness, user satisfaction and company performance stop increasing and start to decrease — following an inverted U-shaped curve. This hypothesis follows previous studies that found a direct relationship between system complexity, system use and perception of usefulness (see, for example, Goodhue and Thompson [20]; Kamis et al. [25]; Speier and Morris [43]; Todd and Benbasat [45]).

Our argument is as follows: When the system is simple, users are able to view and compare alternatives easily. When they make their final decision, they are confident they have considered all the possible options, although they may have selected a suboptimal choice (Huffman and Kahn [22]; Speier and Morris [43]). Nevertheless, they are also aware that doing so was possible without the system and therefore, they may not see the use of the DSS as essential (Kamis